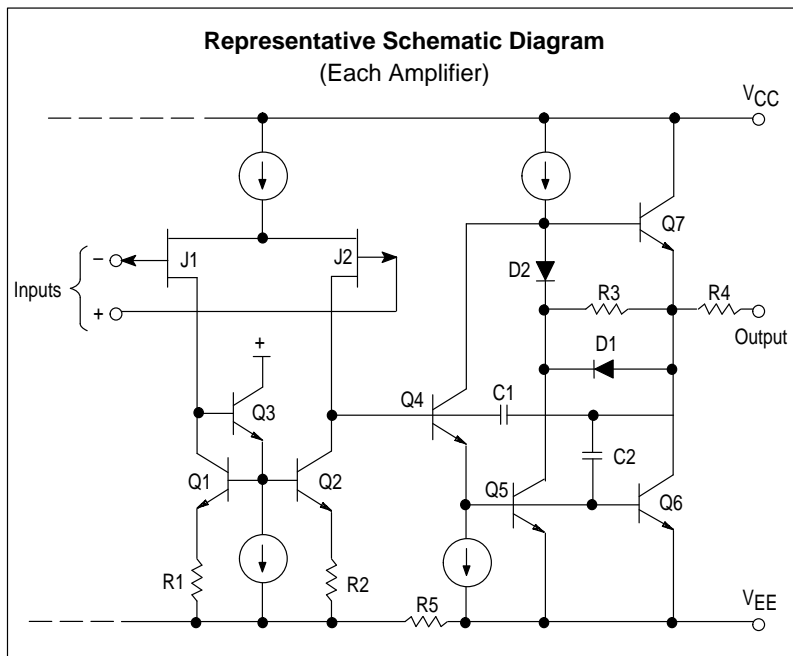


Low Power JFET Input Operational Amplifiers

These JFET input operational amplifiers are designed for low power applications. They feature high input impedance, low input bias current and low input offset current. Advanced design techniques allow for higher slew rates, gain bandwidth products and output swing.

The commercial and vehicular devices are available in Plastic dual in-line and SOIC packages.

- Low Supply Current: 200 μ A/Amplifier
- Low Input Bias Current: 5.0 pA
- High Gain Bandwidth: 2.0 MHz
- High Slew Rate: 6.0 V/ μ s
- High Input Impedance: $10^{12} \Omega$
- Large Output Voltage Swing: ± 14 V
- Output Short Circuit Protection



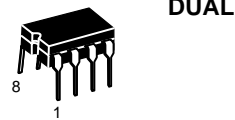
ORDERING INFORMATION

| Op Amp Function | Device | Operating Temperature Range | Package |
|-----------------|------------------------------|--|----------------------|
| Dual | TL062CD, ACD TL062CP, ACP | $T_A = 0^\circ$ to $+70^\circ\text{C}$ | SO-8 Plastic DIP |
| | TL062VD TL062VP | $T_A = -40^\circ$ to $+85^\circ\text{C}$ | SO-8 Plastic DIP |
| Quad | TL064CD, ACD TL064CN, ACN | $T_A = 0^\circ$ to $+70^\circ\text{C}$ | SO-14 Plastic DIP |
| | TL064VD TL064VN | $T_A = -40^\circ$ to $+85^\circ\text{C}$ | SO-14 Plastic DIP |

TL062 TL064

LOW POWER JFET INPUT OPERATIONAL AMPLIFIERS

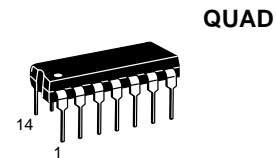
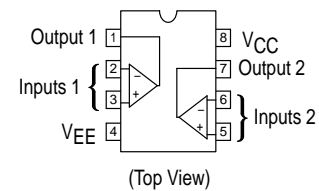
SEMICONDUCTOR TECHNICAL DATA



P SUFFIX
PLASTIC PACKAGE
CASE 626

D SUFFIX
PLASTIC PACKAGE
CASE 751
(SO-8)

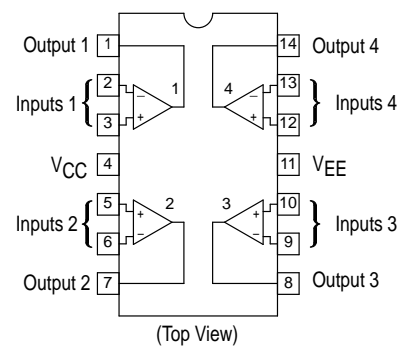
PIN CONNECTIONS



N SUFFIX
PLASTIC PACKAGE
CASE 646

D SUFFIX
PLASTIC PACKAGE
CASE 751A
(SO-14)

PIN CONNECTIONS



TL062 TL064

MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|---|-----------|-------------|--------------------|
| Supply Voltage (from V_{CC} to V_{EE}) | V_S | +36 | V |
| Input Differential Voltage Range (Note 1) | V_{IDR} | ± 30 | V |
| Input Voltage Range (Notes 1 and 2) | V_{IR} | ± 15 | V |
| Output Short Circuit Duration (Note 3) | t_{SC} | Indefinite | sec |
| Operating Junction Temperature | T_J | +150 | $^{\circ}\text{C}$ |
| Storage Temperature Range | T_{stg} | -60 to +150 | $^{\circ}\text{C}$ |

- NOTES:** 1. Differential voltages are at the noninverting input terminal with respect to the inverting input terminal.
 2. The magnitude of the input voltage must never exceed the magnitude of the supply or 15 V, whichever is less.
 3. Power dissipation must be considered to ensure maximum junction temperature (T_J) is not exceeded. (See Figure 1.)

ELECTRICAL CHARACTERISTICS ($V_{CC} = +15\text{ V}$, $V_{EE} = -15\text{ V}$, $T_A = 0^{\circ}$ to $+70^{\circ}\text{C}$, unless otherwise noted.)

| Characteristics | Symbol | TL062AC TL064AC | | | TL062C TL064C | | | Unit |
|---|--------------------------|--------------------|----------------|------------|------------------|----------------|------------|--------------------------------|
| | | Min | Typ | Max | Min | Typ | Max | |
| Input Offset Voltage ($R_S = 50\ \Omega$, $V_O = 0\text{ V}$) $T_A = 25^{\circ}\text{C}$ $T_A = 0^{\circ}$ to $+70^{\circ}\text{C}$ | V_{IO} | — — | 3.0 — | 6.0 7.5 | — — | 3.0 — | 15 20 | mV |
| Average Temperature Coefficient for Offset Voltage ($R_S = 50\ \Omega$, $V_O = 0\text{ V}$) | $\Delta V_{IO}/\Delta T$ | — | 10 | — | — | 10 | — | $\mu\text{V}/^{\circ}\text{C}$ |
| Input Offset Current ($V_{CM} = 0\text{ V}$, $V_O = 0\text{ V}$) $T_A = 25^{\circ}\text{C}$ $T_A = 0^{\circ}$ to $+70^{\circ}\text{C}$ | I_{IO} | — — | 0.5 — | 100 2.0 | — — | 0.5 — | 200 2.0 | pA nA |
| Input Bias Current ($V_{CM} = 0\text{ V}$, $V_O = 0\text{ V}$) $T_A = 25^{\circ}\text{C}$ $T_A = 0^{\circ}$ to $+70^{\circ}\text{C}$ | I_{IB} | — — | 3.0 — | 200 2.0 | — — | 3.0 — | 200 10 | pA nA |
| Input Common Mode Voltage Range $T_A = 25^{\circ}\text{C}$ | V_{ICR} | — -11.5 | +14.5 -12.0 | +11.5 — | — -11 | +14.5 -12.0 | +11 — | V |
| Large Signal Voltage Gain ($R_L = 10\text{ k}\Omega$, $V_O = \pm 10\text{ V}$) $T_A = 25^{\circ}\text{C}$ $T_A = 0^{\circ}$ to $+70^{\circ}\text{C}$ | A_{VOL} | 4.0 4.0 | 58 — | — — | 3.0 3.0 | 58 — | — — | V/mV |
| Output Voltage Swing ($R_L = 10\text{ k}\Omega$, $V_{ID} = 1.0\text{ V}$) $T_A = 25^{\circ}\text{C}$ | V_{O+} V_{O-} | +10 — | +14 -14 | — -10 | +10 — | +14 -14 | — -10 | V |
| $T_A = 0^{\circ}$ to $+70^{\circ}\text{C}$ | V_{O+} V_{O-} | +10 — | — — | — -10 | +10 — | — — | — -10 | |
| Common Mode Rejection ($R_S = 50\ \Omega$, $V_{CM} = V_{ICR}\text{ min}$, $V_O = 0\text{ V}$, $T_A = 25^{\circ}\text{C}$) | CMR | 80 | 84 | — | 70 | 84 | — | dB |
| Power Supply Rejection ($R_S = 50\ \Omega$, $V_{CM} = 0\text{ V}$, $V_O = 0$, $T_A = 25^{\circ}\text{C}$) | PSR | 80 | 86 | — | 70 | 86 | — | dB |
| Power Supply Current (each amplifier) (No Load, $V_O = 0\text{ V}$, $T_A = 25^{\circ}\text{C}$) | I_D | — | 200 | 250 | — | 200 | 250 | μA |
| Total Power Dissipation (each amplifier) (No Load, $V_O = 0\text{ V}$, $T_A = 25^{\circ}\text{C}$) | P_D | — | 6.0 | 7.5 | — | 6.0 | 7.5 | mW |

TL062 TL064

DC ELECTRICAL CHARACTERISTICS ($V_{CC} = +15\text{ V}$, $V_{EE} = -15\text{ V}$, $T_A = T_{low}$ to T_{high} [Note 4], unless otherwise noted.)

| Characteristics | Symbol | TL062V | | | TL064V | | | Unit |
|--|--|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|------------------------------|
| | | Min | Typ | Max | Min | Typ | Max | |
| Input Offset Voltage ($R_S = 50\ \Omega$, $V_O = 0\text{ V}$) $T_A = 25^\circ\text{C}$ $T_A = T_{low}$ to T_{high} | V_{IO} | — — | 3.0 — | 6.0 9.0 | — — | 3.0 — | 9.0 15 | mV |
| Average Temperature Coefficient for Offset Voltage ($R_S = 50\ \Omega$, $V_O = 0\text{ V}$) | $\Delta V_{IO}/\Delta T$ | — | 10 | — | — | 10 | — | $\mu\text{V}/^\circ\text{C}$ |
| Input Offset Current ($V_{CM} = 0\text{ V}$, $V_O = 0\text{ V}$) $T_A = 25^\circ\text{C}$ $T_A = T_{low}$ to T_{high} | I_{IO} | — — | 5.0 — | 100 20 | — — | 5.0 — | 100 20 | pA nA |
| Input Bias Current ($V_{CM} = 0\text{ V}$, $V_O = 0\text{ V}$) $T_A = 25^\circ\text{C}$ $T_A = T_{low}$ to T_{high} | I_{IB} | — — | 30 — | 200 50 | — — | 30 — | 200 50 | pA nA |
| Input Common Mode Voltage Range ($T_A = 25^\circ\text{C}$) | V_{ICR} | — -11.5 | +14.5 -12.0 | +11.5 — | — -11.5 | +14.5 -12.0 | +11.5 — | V |
| Large Signal Voltage Gain ($R_L = 10\text{ k}\Omega$, $V_O = \pm 10\text{ V}$) $T_A = 25^\circ\text{C}$ $T_A = T_{low}$ to T_{high} | A_{VOL} | 4.0 4.0 | 58 — | — — | 4.0 4.0 | 58 — | — — | V/mV |
| Output Voltage Swing ($R_L = 10\text{ k}\Omega$, $V_{ID} = 1.0\text{ V}$) $T_A = 25^\circ\text{C}$ $T_A = T_{low}$ to T_{high} | V_{O+} V_{O-} V_{O+} V_{O-} | +10 — +10 — | +14 -14 — — | — -10 — -10 | +10 — +10 — | +14 -14 — — | — -10 — -10 | V |
| Common Mode Rejection ($R_S = 50\ \Omega$, $V_{CM} = V_{ICR\ min}$, $V_O = 0$, $T_A = 25^\circ\text{C}$) | CMR | 80 | 84 | — | 80 | 84 | — | dB |
| Power Supply Rejection ($R_S = 50\ \Omega$, $V_{CM} = 0\text{ V}$, $V_O = 0$, $T_A = 25^\circ\text{C}$) | PSR | 80 | 86 | — | 80 | 86 | — | dB |
| Power Supply Current (each amplifier) (No Load, $V_O = 0\text{ V}$, $T_A = 25^\circ\text{C}$) | I_D | — | 200 | 250 | — | 200 | 250 | μA |
| Total Power Dissipation (each amplifier) (No Load, $V_O = 0\text{ V}$, $T_A = 25^\circ\text{C}$) | P_D | — | 6.0 | 7.5 | — | 6.0 | 7.5 | mW |

NOTE: 4. $T_{low} = -40^\circ\text{C}$ $T_{high} = +85^\circ\text{C}$ for TL062,4V

AC ELECTRICAL CHARACTERISTICS ($V_{CC} = +15\text{ V}$, $V_{EE} = -15\text{ V}$, $T_A = +25^\circ\text{C}$, unless otherwise noted.)

| Characteristics | Symbol | Min | Typ | Max | Unit |
|---|--------|--------|------------|--------|------------------------------|
| Slew Rate ($V_{in} = -10\text{ V}$ to $+10\text{ V}$, $R_L = 10\text{ k}\Omega$, $C_L = 100\text{ pF}$, $A_V = +1.0$) | SR | 2.0 | 6.0 | — | V/ μs |
| Rise Time ($V_{in} = 20\text{ mV}$, $R_L = 10\text{ k}\Omega$, $C_L = 100\text{ pF}$, $A_V = +1.0$) | t_r | — | 0.1 | — | μs |
| Overshoot ($V_{in} = 20\text{ mV}$, $R_L = 10\text{ k}\Omega$, $C_L = 100\text{ pF}$, $A_V = +1.0$) | OS | — | 10 | — | % |
| Settling Time ($V_{CC} = +15\text{ V}$, $V_{EE} = -15\text{ V}$, $A_V = -1.0$, $R_L = 10\text{ k}\Omega$, $V_O = 0\text{ V}$ to $+10\text{ V}$ step) | t_S | — — | 1.6 2.2 | — — | μs |
| To within 10 mV | | | | | |
| To within 1.0 mV | | | | | |
| Gain Bandwidth Product ($f = 200\text{ kHz}$) | GBW | — | 2.0 | — | MHz |
| Equivalent Input Noise ($R_S = 100\ \Omega$, $f = 1.0\text{ kHz}$) | e_n | — | 47 | — | $\text{nV}/\sqrt{\text{Hz}}$ |
| Input Resistance | R_i | — | 10^{12} | — | Ω |
| Channel Separation ($f = 10\text{ kHz}$) | CS | — | 120 | — | dB |

Figure 1. Maximum Power Dissipation versus Temperature for Package Variations

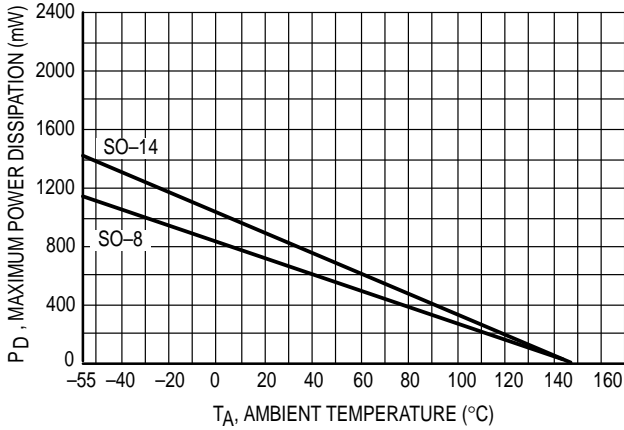


Figure 2. Output Voltage Swing versus Supply Voltage

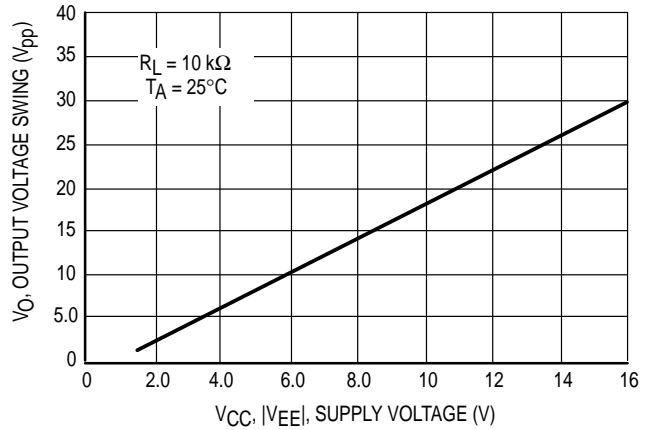


Figure 3. Output Voltage Swing versus Temperature

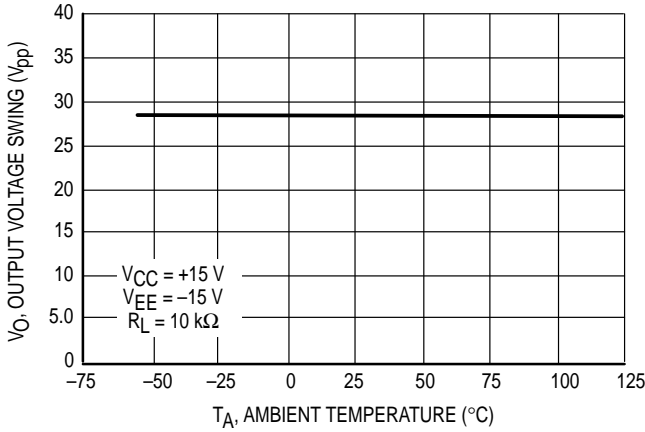


Figure 4. Output Voltage Swing versus Load Resistance

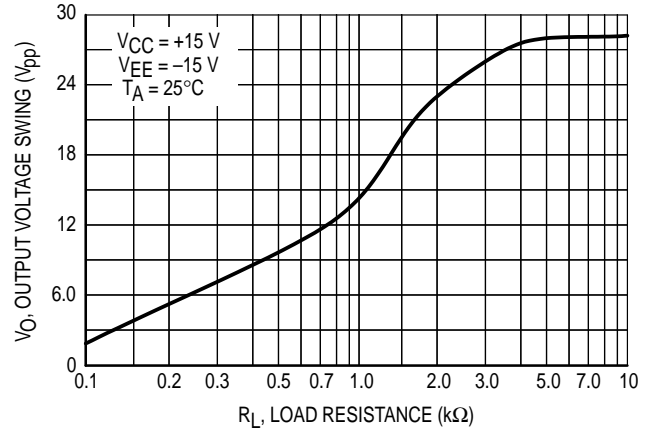


Figure 5. Output Voltage Swing versus Frequency

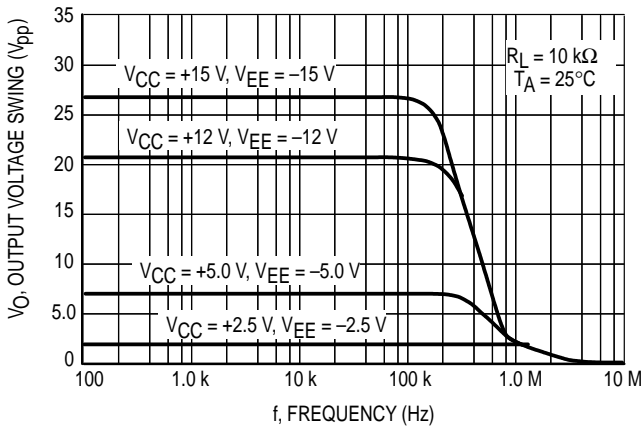


Figure 6. Large Signal Voltage Gain versus Temperature

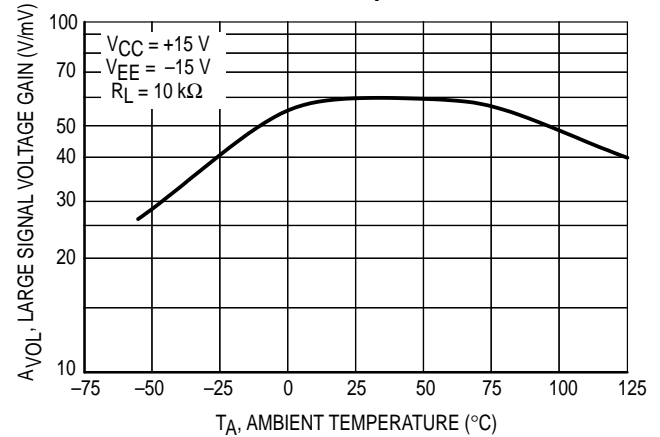


Figure 7. Open Loop Voltage Gain and Phase versus Frequency

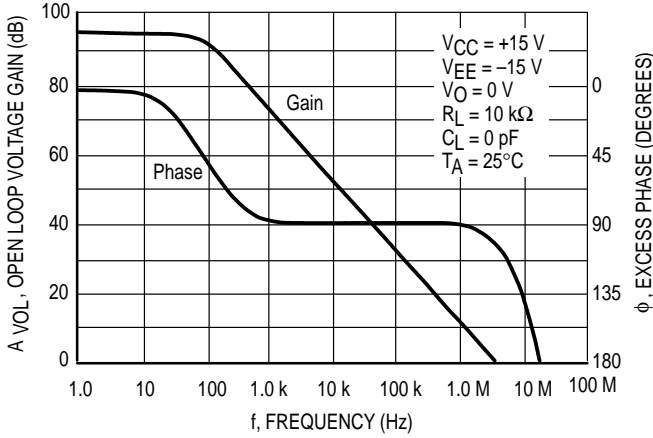


Figure 8. Supply Current per Amplifier versus Supply Voltage

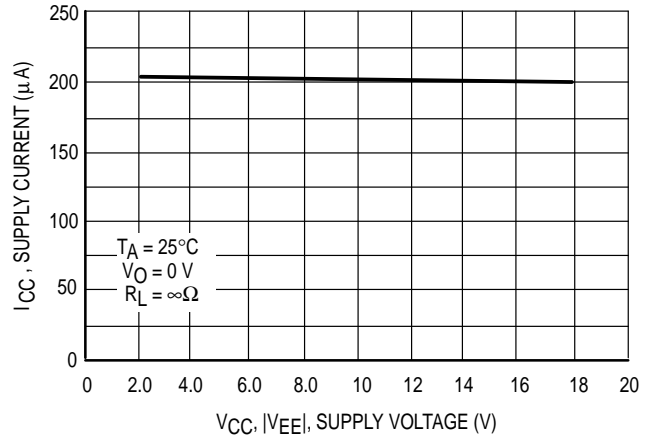


Figure 9. Supply Current per Amplifier versus Temperature

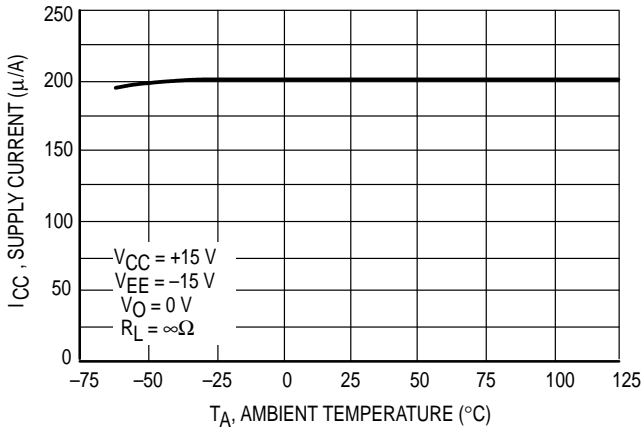


Figure 10. Total Power Dissipation versus Temperature

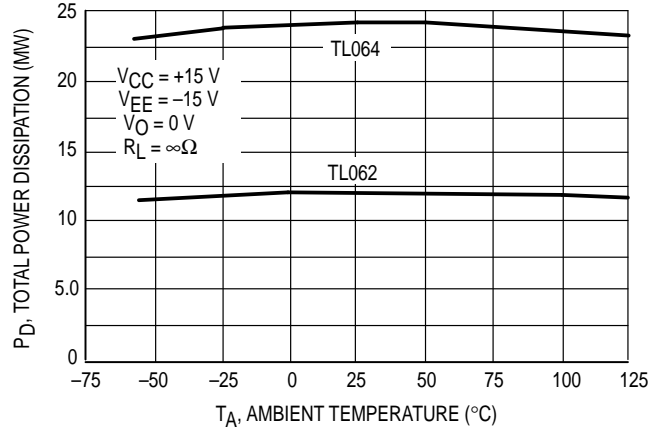


Figure 11. Common Mode Rejection versus Temperature

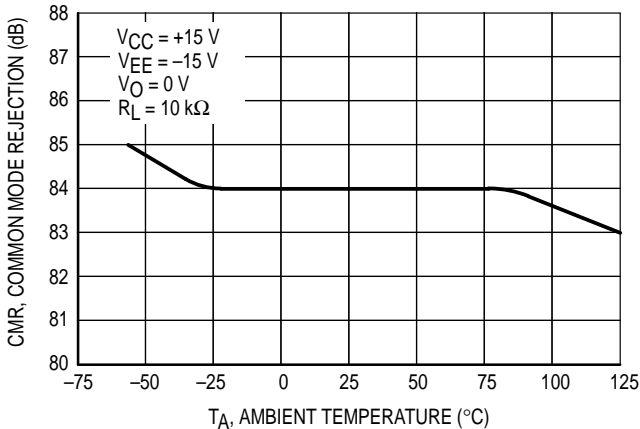


Figure 12. Common Mode Rejection versus Frequency

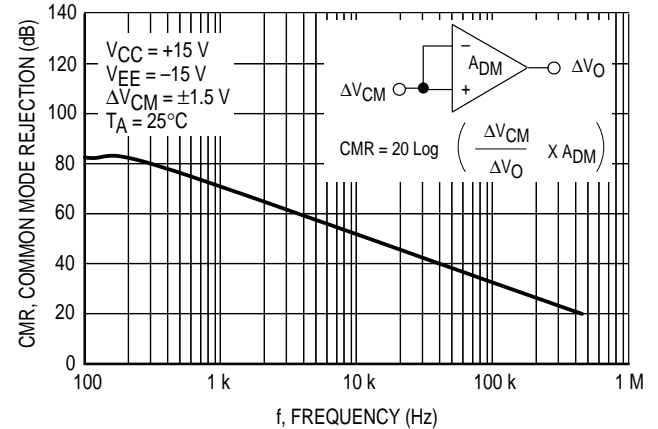


Figure 13. Power Supply Rejection versus Frequency

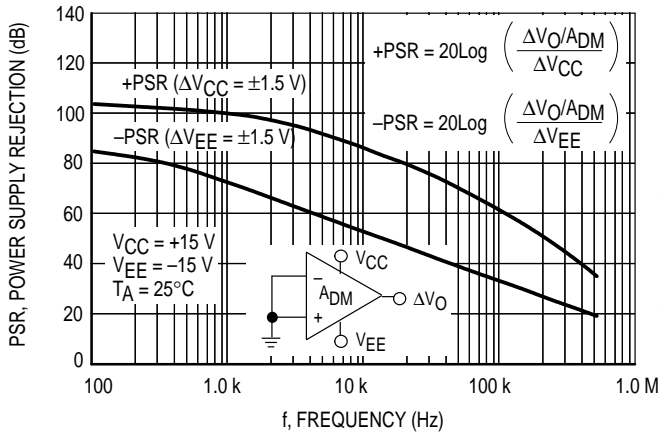


Figure 14. Normalized Gain Bandwidth Product, Slew Rate and Phase Margin versus Temperature

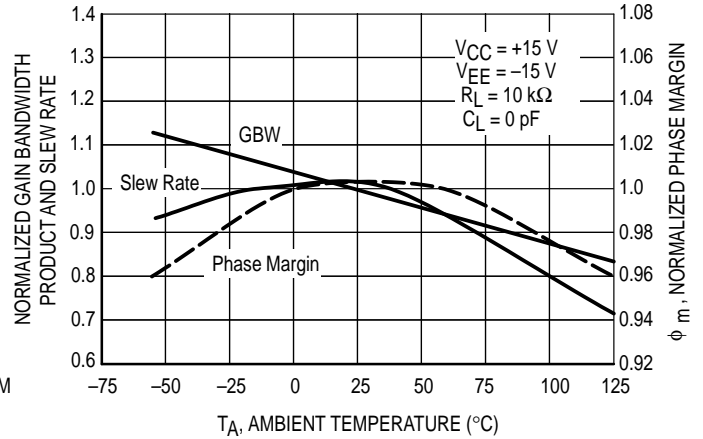


Figure 15. Input Bias Current versus Temperature

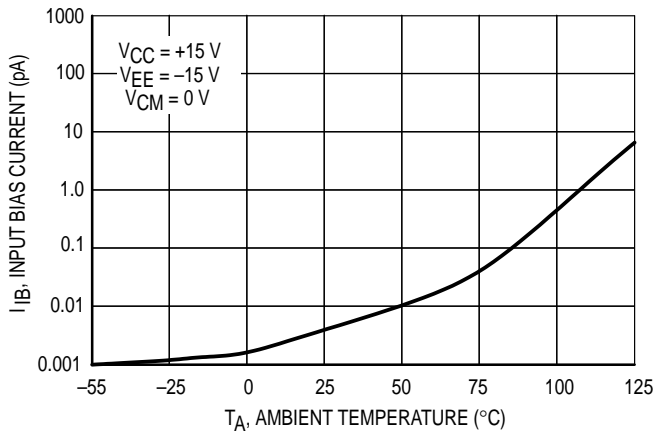


Figure 16. Input Noise Voltage versus Frequency

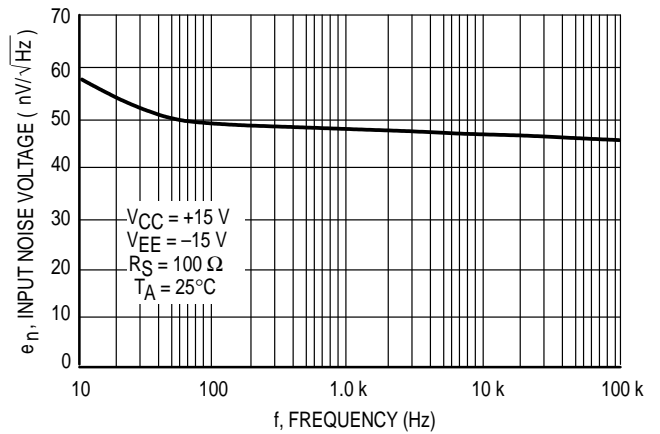


Figure 17. Small Signal Response

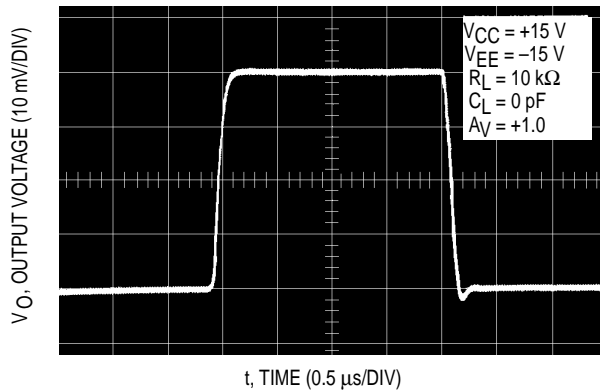
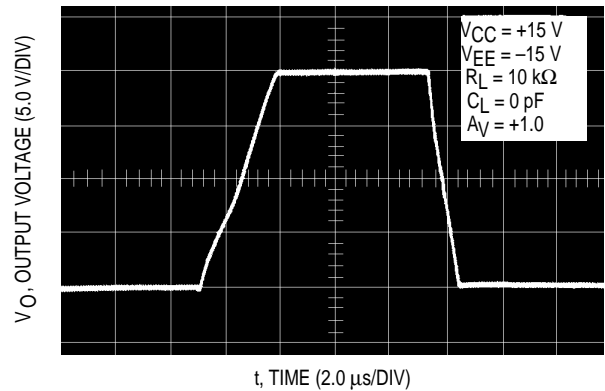


Figure 18. Large Signal Response



TL062 TL064

Figure 19. AC Amplifier

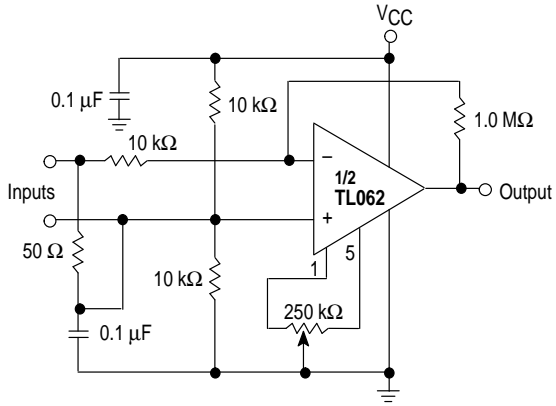


Figure 20. High-Q Notch Filter

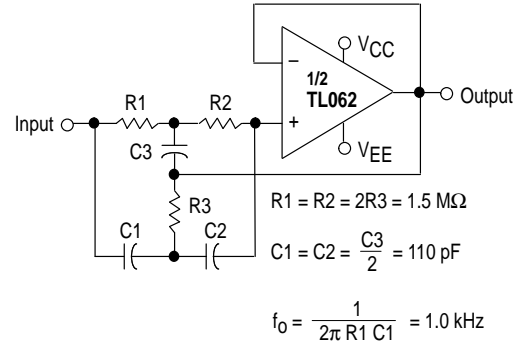


Figure 21. Instrumentation Amplifier

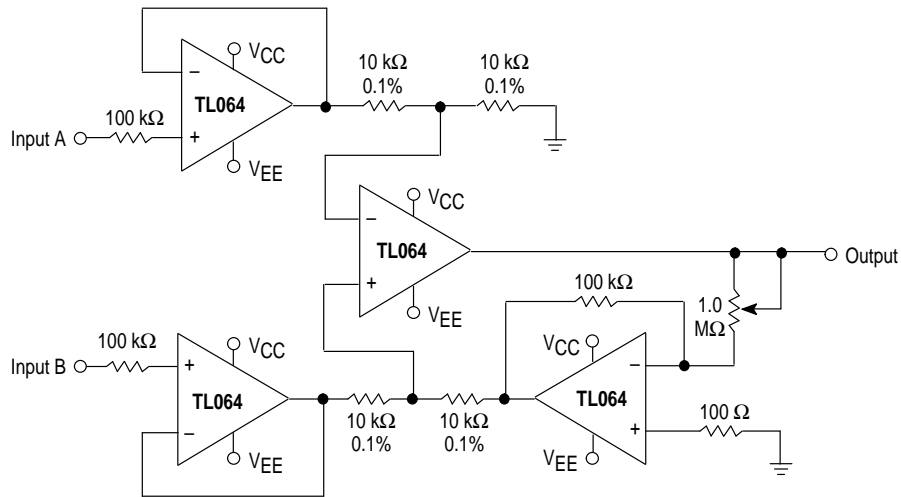


Figure 22. 0.5 Hz Square-Wave Oscillator

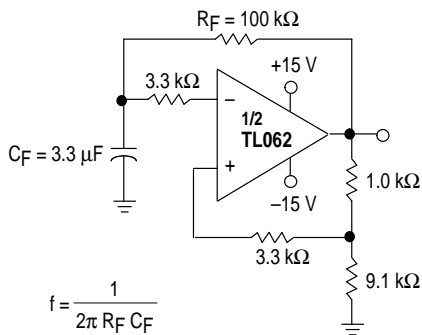
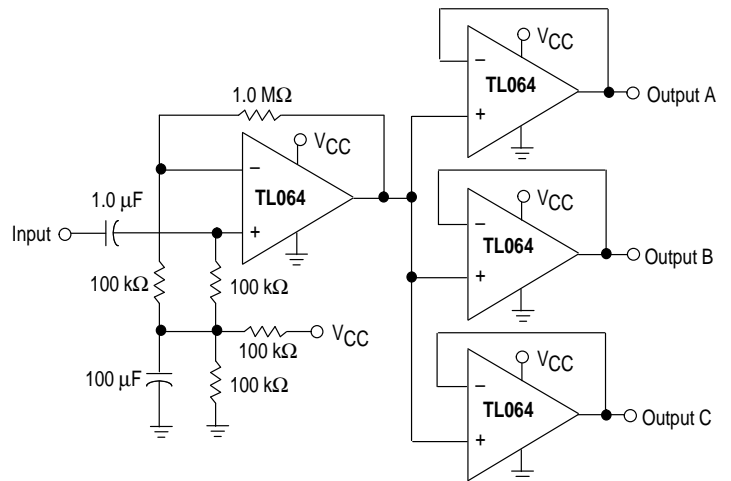


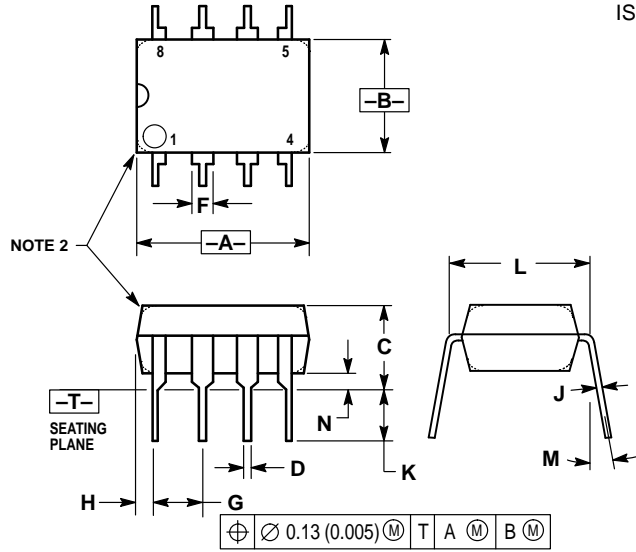
Figure 23. Audio Distribution Amplifier



TL062 TL064

OUTLINE DIMENSIONS

P SUFFIX PLASTIC PACKAGE CASE 626-05 ISSUE K

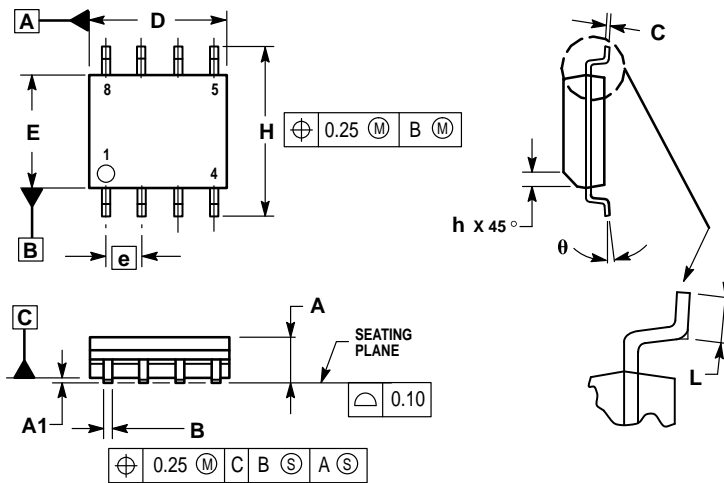


NOTES:

1. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
2. PACKAGE CONTOUR OPTIONAL (ROUND OR SQUARE CORNERS).
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|-------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 9.40 | 10.16 | 0.370 | 0.400 |
| B | 6.10 | 6.60 | 0.240 | 0.260 |
| C | 3.94 | 4.45 | 0.155 | 0.175 |
| D | 0.38 | 0.51 | 0.015 | 0.020 |
| F | 1.02 | 1.78 | 0.040 | 0.070 |
| G | 2.54 BSC | | 0.100 BSC | |
| H | 0.76 | 1.27 | 0.030 | 0.050 |
| J | 0.20 | 0.30 | 0.008 | 0.012 |
| K | 2.92 | 3.43 | 0.115 | 0.135 |
| L | 7.62 BSC | | 0.300 BSC | |
| M | — | | 10° | |
| N | 0.76 | 1.01 | 0.030 | 0.040 |

D SUFFIX PLASTIC PACKAGE CASE 751-05 (SO-8) ISSUE R



NOTES:

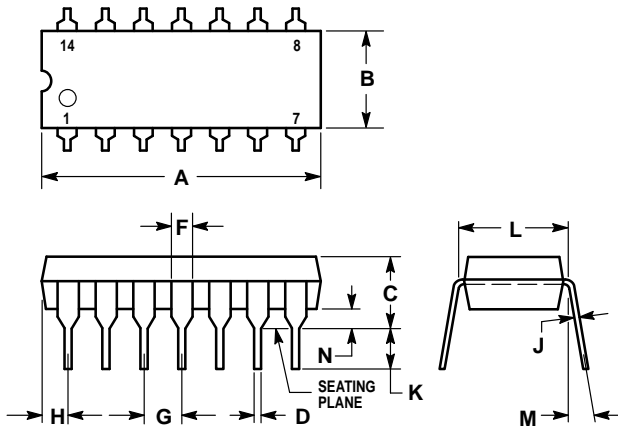
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. DIMENSIONS ARE IN MILLIMETERS.
3. DIMENSION D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE MOLD PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 TOTAL IN EXCESS OF THE B DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS | |
|-----|-------------|------|
| | MIN | MAX |
| A | 1.35 | 1.75 |
| A1 | 0.10 | 0.25 |
| B | 0.35 | 0.49 |
| C | 0.18 | 0.25 |
| D | 4.80 | 5.00 |
| E | 3.80 | 4.00 |
| e | 1.27 BSC | |
| H | 5.80 | 6.20 |
| h | 0.25 | 0.50 |
| L | 0.40 | 1.25 |
| θ | 0° 7° | |

TL062 TL064

OUTLINE DIMENSIONS

N SUFFIX PLASTIC PACKAGE CASE 646-06 ISSUE L

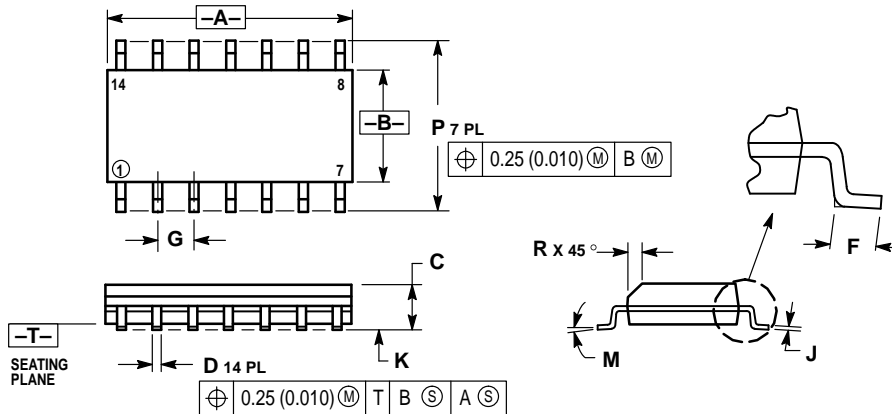


NOTES:

- LEADS WITHIN 0.13 (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
- DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
- DIMENSION B DOES NOT INCLUDE MOLD FLASH.
- ROUNDED CORNERS OPTIONAL.

| DIM | INCHES | | MILLIMETERS | |
|-----|-----------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.715 | 0.770 | 18.16 | 19.56 |
| B | 0.240 | 0.260 | 6.10 | 6.60 |
| C | 0.145 | 0.185 | 3.69 | 4.69 |
| D | 0.015 | 0.021 | 0.38 | 0.53 |
| F | 0.040 | 0.070 | 1.02 | 1.78 |
| G | 0.100 BSC | | 2.54 BSC | |
| H | 0.052 | 0.095 | 1.32 | 2.41 |
| J | 0.008 | 0.015 | 0.20 | 0.38 |
| K | 0.115 | 0.135 | 2.92 | 3.43 |
| L | 0.300 BSC | | 7.62 BSC | |
| M | 0° | 10° | 0° | 10° |
| N | 0.015 | 0.039 | 0.39 | 1.01 |

D SUFFIX PLASTIC PACKAGE CASE 751A-03 (SO-14) ISSUE F



NOTES:

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: MILLIMETER.
- DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
- MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
- DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 8.55 | 8.75 | 0.337 | 0.344 |
| B | 3.80 | 4.00 | 0.150 | 0.157 |
| C | 1.35 | 1.75 | 0.054 | 0.068 |
| D | 0.35 | 0.49 | 0.014 | 0.019 |
| F | 0.40 | 1.25 | 0.016 | 0.049 |
| G | 1.27 BSC | | 0.050 BSC | |
| J | 0.19 | 0.25 | 0.008 | 0.009 |
| K | 0.10 | 0.25 | 0.004 | 0.009 |
| M | 0° | 7° | 0° | 7° |
| P | 5.80 | 6.20 | 0.228 | 0.244 |
| R | 0.25 | 0.50 | 0.010 | 0.019 |

TL062 TL064
NOTES

TL062 TL064
NOTES

TL062 TL064

Motorola reserves the right to make changes without further notice to any products herein. Motorola makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Motorola assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters which may be provided in Motorola data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. Motorola does not convey any license under its patent rights nor the rights of others. Motorola products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Motorola product could create a situation where personal injury or death may occur. Should Buyer purchase or use Motorola products for any such unintended or unauthorized application, Buyer shall indemnify and hold Motorola and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Motorola was negligent regarding the design or manufacture of the part. Motorola and  are registered trademarks of Motorola, Inc. Motorola, Inc. is an Equal Opportunity/Affirmative Action Employer.

How to reach us:

USA/EUROPE/Locations Not Listed: Motorola Literature Distribution;
P.O. Box 20912; Phoenix, Arizona 85036. 1-800-441-2447 or 602-303-5454

JAPAN: Nippon Motorola Ltd.; Tatsumi-SPD-JLDC, 6F Seibu-Butsuryu-Center,
3-14-2 Tatsumi Koto-Ku, Tokyo 135, Japan. 03-81-3521-8315

MFAX: RMFAX0@email.sps.mot.com – TOUCHTONE 602-244-6609
INTERNET: <http://Design-NET.com>

ASIA/PACIFIC: Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park,
51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852-26629298



TL062/D

